

Strategy – Implementation of “ The Safety Edge”

General Description

On average, North Carolina roadways experience more than 50,000 lane departure crashes each year, equating to 137 lane departure crashes each and every day. Many of these crashes involve vehicles that run off the road either to the left, right, or straight and then lose control as the driver attempts to renegotiate the vehicle safely back onto the roadway. It is unknown how many of these crashes can be attributed to unsafe pavement edges but it is estimated that each year in the United States, 11,000 Americans suffer injuries and 160 die in crashes related to faulty shoulder edges. Research has shown that vertical pavement edge drop-offs of three inches or less can contribute to vehicular loss of control, leading to a subsequent crash. This strategy addresses the unsafe pavement edge issue by the adoption of a standard contract specification requiring an asphalt fillet, “Safety Edge” of no more than a 45 % angle along each side of the roadway in all paving projects on state system roadways in North Carolina. The Asphalt fillet provides a safer roadway edge as well as a stronger interface between the roadway and the unpaved shoulder, making it more negotiable for errant vehicles. The cost of the asphalt fillet is minimal when compared to the total cost of yearly paving contracts in North Carolina. The benefits are numerous when considering the asphalt fillet will go a long ways in reducing the number of fatalities, injuries, property damage and lawsuits involving lane departure related crashes on North Carolina roadways.

One of the major problems caused by pavement edge drop-offs occurs when a vehicle attempts to reenter the travel lane at a low return angle, which causes the tires to scrub against the pavement edge. When this occurs, the driver instinctively tries to overcome the resistance of the scrubbing by increasing the steering until the front wheel steer angle is large enough to overcome the pavement edge drop-off. Once the front tire clears the pavement edge, the large steer angle can produce a slingshot effect, causing the vehicle to cross the centerline or median and possibly into oncoming traffic. Crashes of this type are normally considered “Over-correction” related crashes and many times the investigating officer will note in the narrative that the driver over corrected.

Even though many pavement edge related crashes are caused by over correction, there is at least one other crash scenario that can be contributed to pavement edge drop-offs. This crash scenario occurs when a driver is unable to renegotiate back into the travel lane due to a significant pavement edge drop and the vehicle eventually hits a fixed object, travels down or up an embankment and/or overturns. In 2003, 608 people were killed on NC roadways when the vehicles they were traveling in ran off the road, hit a fixed object and/or overturned. It is unclear how many if any of these fatalities could be attributed to low pavement edges. However, based on past research by institutions such as Georgia Institute of Technology and FHWA, significant pavement drop-offs can be found at many severe injury and fatal crash sites involving vehicles that run off the road.

Another important point to remember is that certain types of vehicles such as motorcycles, sub-compact vehicles, and tractor trailers have a much higher sensitivity to pavement edge drops than

do full-size automobiles that have been thoroughly tested. Motorcycles for example are very unstable on uneven surfaces and riders can easily lose control on just marginally low pavement edges. On the other hand, large trucks with a high center of gravity are very prone to rollovers especially when the pavement edge drop-off are six inches or greater.

Technical Attributes

Target	Reduce the number of run-off-road crashes involving drivers losing control of their vehicles when attempting to reenter the roadway from a pavement edge drop-off. The high emphasis corridors should be the 2 lane roadways where 77% of all lane departures occur and where 80% of lane departure crashes are occurring. Subsequent to reducing run off road crashes, the net effect should be a significant reduction in property damage caused by lane departure crashes as well as a reduction in the number of lawsuits against the NCDOT.
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Expected Effectiveness	<p>The effects of implementing the asphalt fillet or “Safety Edge” on all paving projects in North Carolina would obviously assist in the reduction of lane departure crashes on state system roadways. With over 50,000 lane departure crashes occurring on NC highways each year, the positive impact that the “Safety Edge” could have on the reduction of crashes, property damage, and lawsuits in this state could be enormous. Unfortunately, there is no hard data that quantifies the anticipated benefits or expected crash reduction factors for implementing the “Safety Edge”. However, in the published document, “The Elimination or Mitigation of Hazards Associated with Pavement Edge Drop-offs During Roadway Resurfacing, authors J. B Humphreys and J. A. Parham conclude that a 45-degree angle asphalt fillet placed at the lane edge would virtually eliminate crashes involving over correction, even in cases where the shoulder is unpaved and suffers subsequent erosion damage. NCHRP Report 500 Volume 6 also notes the conclusions made by these two authors. Thus, it is safe to assume that a significant percentage of fatal crashes and other run off road related crashes could be prevented with the adoption of a standard contract specification requiring a “Safety Edge” along each side of the roadway in all NCDOT paving contracts.</p>
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An added benefit of requiring the “Safety Edge” could be realized as early as the resurfacing of an existing roadway. With the current NCDOT practice, significant vertical edge drop-offs are created as soon as the roadway is resurfaced. Unfortunately, there can be a significant amount of time between the resurfacing of the roadway and the shoulder reconstruction. During this time, which can last for a month or more, a significant pavement edge drop-off exists along the resurfaced route, presenting a significant danger to errant vehicles. The implementation of the “Safety Edge” would significantly reduce this danger by providing a smoother transition between the roadway and unpaved shoulder, and subsequently, it would help reduce the number of run off road type crashes experienced while a paving projects are under construction. The 2002 Roadside Design Guide recommends that pavement edge drop-offs greater than 3 inches immediately adjacent to traffic not be left overnight. If this is not possible, the guide suggests mitigating measures such as adding a wedge of stable material at a 45 degree angle or flatter slope be considered along the face of the drop-off. By implementing the “Safety Edge” into all resurfacing projects, the need to provide this temporary measure would be eliminated.

Keys to Success

One of the major keys to success is the adoption of a standard contract specification that pertains to all paving projects within the state no matter the roadway classification (interstate, secondary route, etc.). Historically, North Carolina as well as most other states have chosen to try new innovations and experimental countermeasures on the higher volume, higher classification roadways before disseminating to the lower classifications. With approximately 80% of all fatal lane departure crashes occurring on two lane roadways, it would be a mistake to take this approach with the “Safety Edge”. It is critical that a program be developed that includes all roadway classifications upfront at the start of the program. If a trial implementation of the “Safety Edge” is taken, it is critical to pick corridors that are experiencing high lane departure crash rates. Routes with narrow lanes and shoulders as well as curvy alignment should be chosen for test sections as well as higher classification routes with a demonstrated need for the “Safety Edge”.

Another key to success with this strategy will be the success of “champion” states that have implemented the asphalt fillet, “Safety Edge” treatment as a standard part of their paving projects and have found the treatment to be low cost and effective in reducing crashes. Currently, there are 7 or 8 states and a few municipalities using some type of angled asphalt pavement edge in some or all of their resurfacing projects. Like with most experimental innovations, State DOT’s are reluctant to implement a measure with a significant cost without some proven background data supporting the measure. The same is true with the Safety Edge. The success of these “champion” agencies will be critical in selling the “Safety Edge” to the NCDOT as a whole.

Potential Difficulties

Considering the current funding deficiencies with the NCDOT, it may be difficult to convince the department decision makers to increase funding for all paving projects so that the “Safety Edge” can be incorporated statewide. The key to overcoming this potential difficulty will be educating everyone on the tremendous benefits of the “Safety Edge” and the low cost associated with its implementation.

Another potential difficulty may be identifying test corridors or sections of roadway to implement the “Safety Edge” if it is decided that a stepped approach will be taken in the implementation of the “Safety Edge”. Selecting the most appropriate test sections will be a difficult task especially considering that North Carolina has more than 78,000 miles of state maintained roadways. Crash data along with site specific characteristics such as lane & shoulder widths, horizontal alignment, and valuable input from field engineers will play a critical role in the assurance that the best test locations are selected for a scaled down “Safety Edge” program.

Appropriate Measures and Data

In the evaluation of this strategy’s effectiveness, impact measures such as the total lane departure crashes reduced by the “Safety Edge” would be needed along all of the corridors where this improvement is implemented. Also, if there is a desire to measure the impact the “Safety Edge” has on maintenance operations, it would be critical to keep accurate and up to date maintenance records/data on each applicable corridor before and after the “Safety Edge” is installed. Analyzing the before & after data should give maintenance personnel an idea on what impact the “Safety Edge” had on maintenance operations, either positive or negative.

Another measurement that needs to be tracked would be the cost impact the “Safety Edge” has on resurfacing and new pavement contracts. A substantial amount of before and after cost data for asphalt paving would need to be analyzed before a definitive cost can be applied to the “Safety Edge”

Associated Needs	None identified.
Organizational, Institutional, and Policy Issues	Implementing the “Safety Edge” statewide would require a change in the standard specifications, at least on Non-TIP projects. A detail or standard drawing for the “Safety Edge” may need to be developed and included in the department’s standard drawings. Since the “Safety Edge” is somewhat of a standard treatment and has little or no impact on the environment, there should not be a need for cooperative efforts with other agencies.
Issues Affecting Implementation Time	One issue that might affect implementation would be ensuring that all contractor and DOT asphalt paving machines have the needed edging devices installed prior to the paving or resurfacing of a particular roadway. Funding is always an issue but due to the very minimal cost associated with the “Safety Edge”, few or no delays should be expected in the implementation time.
Costs	The Georgia DOT estimates that the associated cost with implementing the “Safety Edge” into resurfacing projects is less than 1% of the pavement resurfacing budget. Humphreys and Parham (1994) note that the cost of adding a pavement edge fillet in a resurfacing project is very low, perhaps 1-2 percent of the total resurfacing cost.
Training	The only anticipated training associated with this strategy would be for the paving and inspection forces (state and contract) responsible for placing or overseeing the placement of the “Safety Edge”.
Legislative Needs	None at this time.

References

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